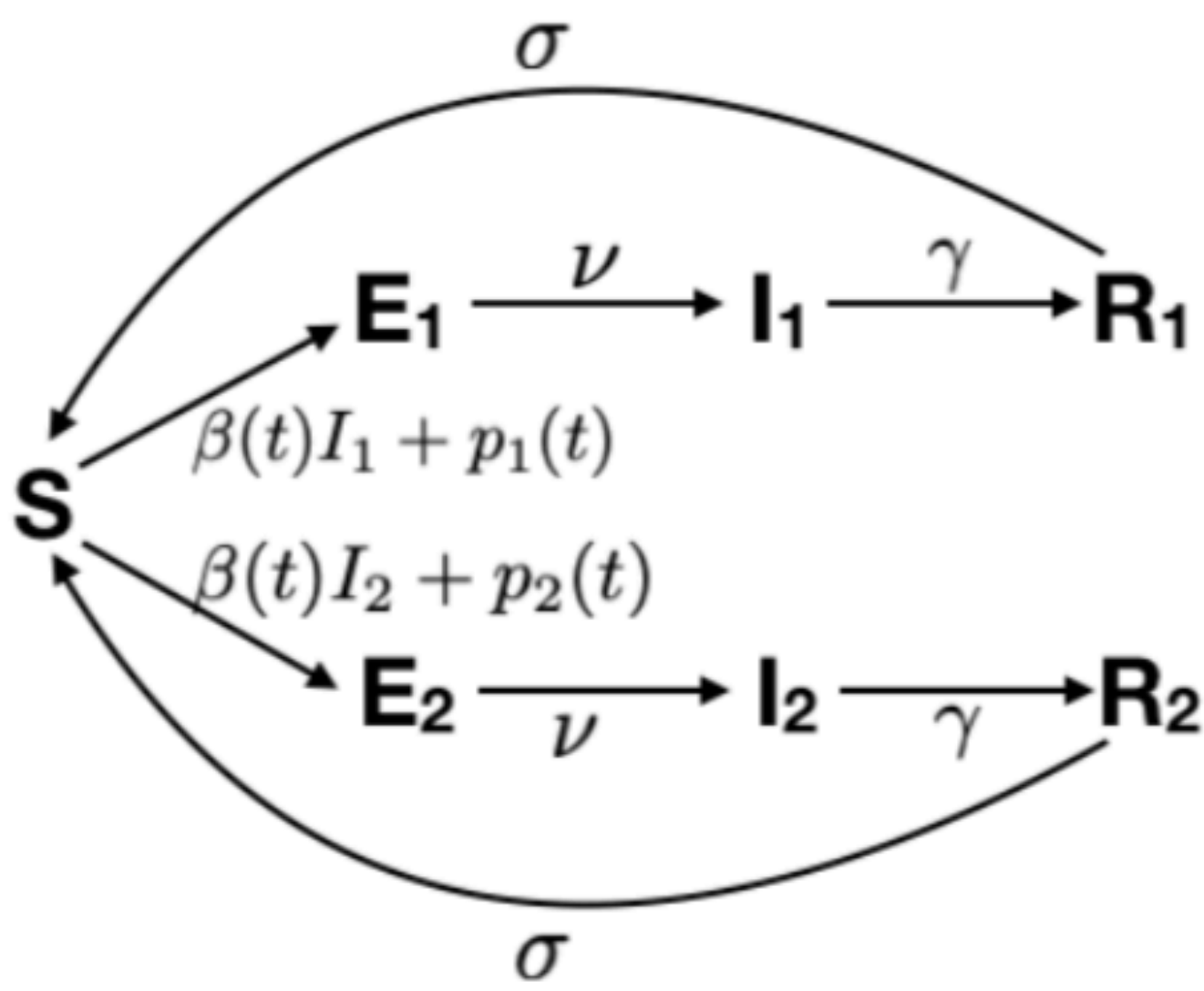
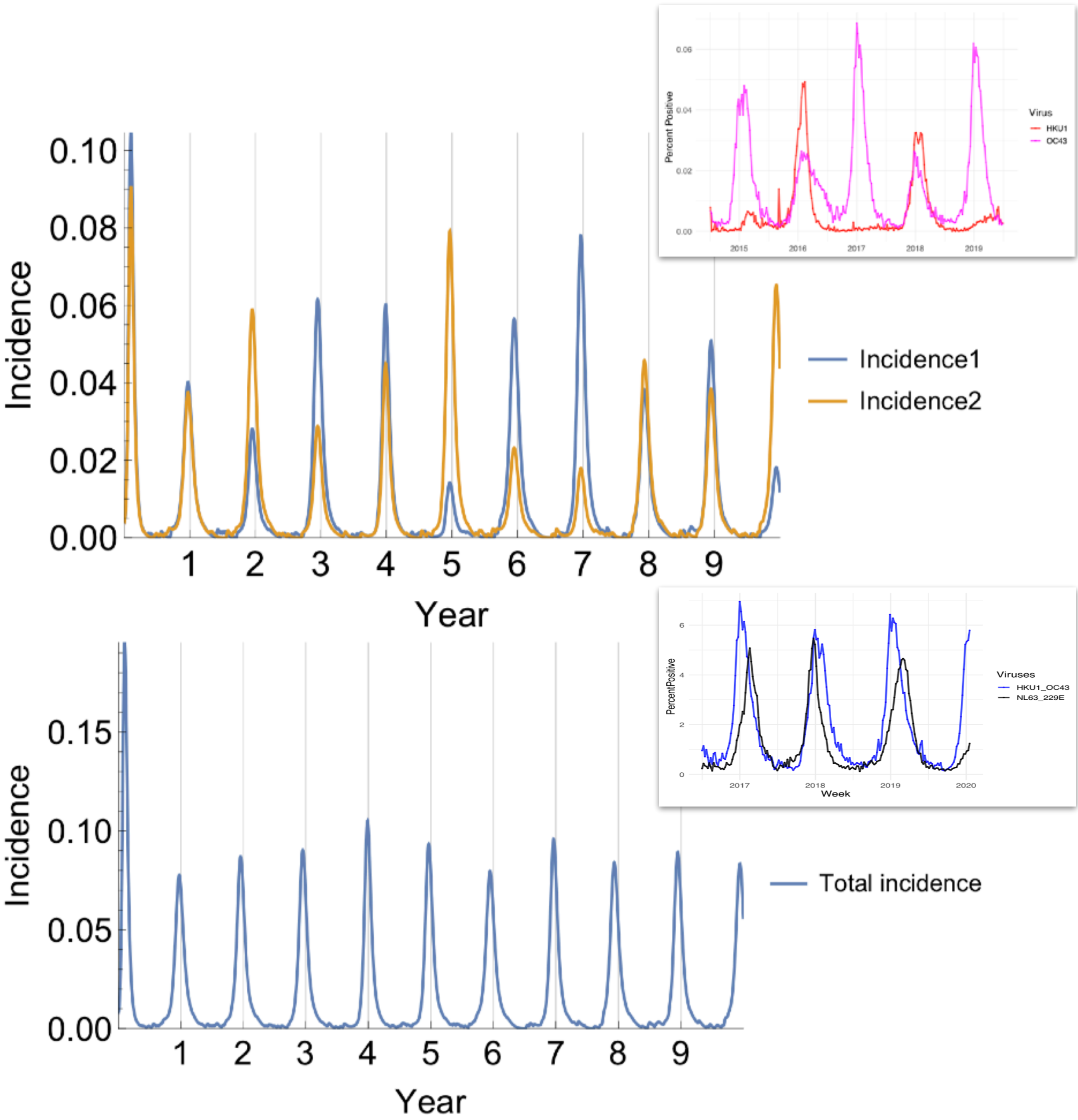


Early models

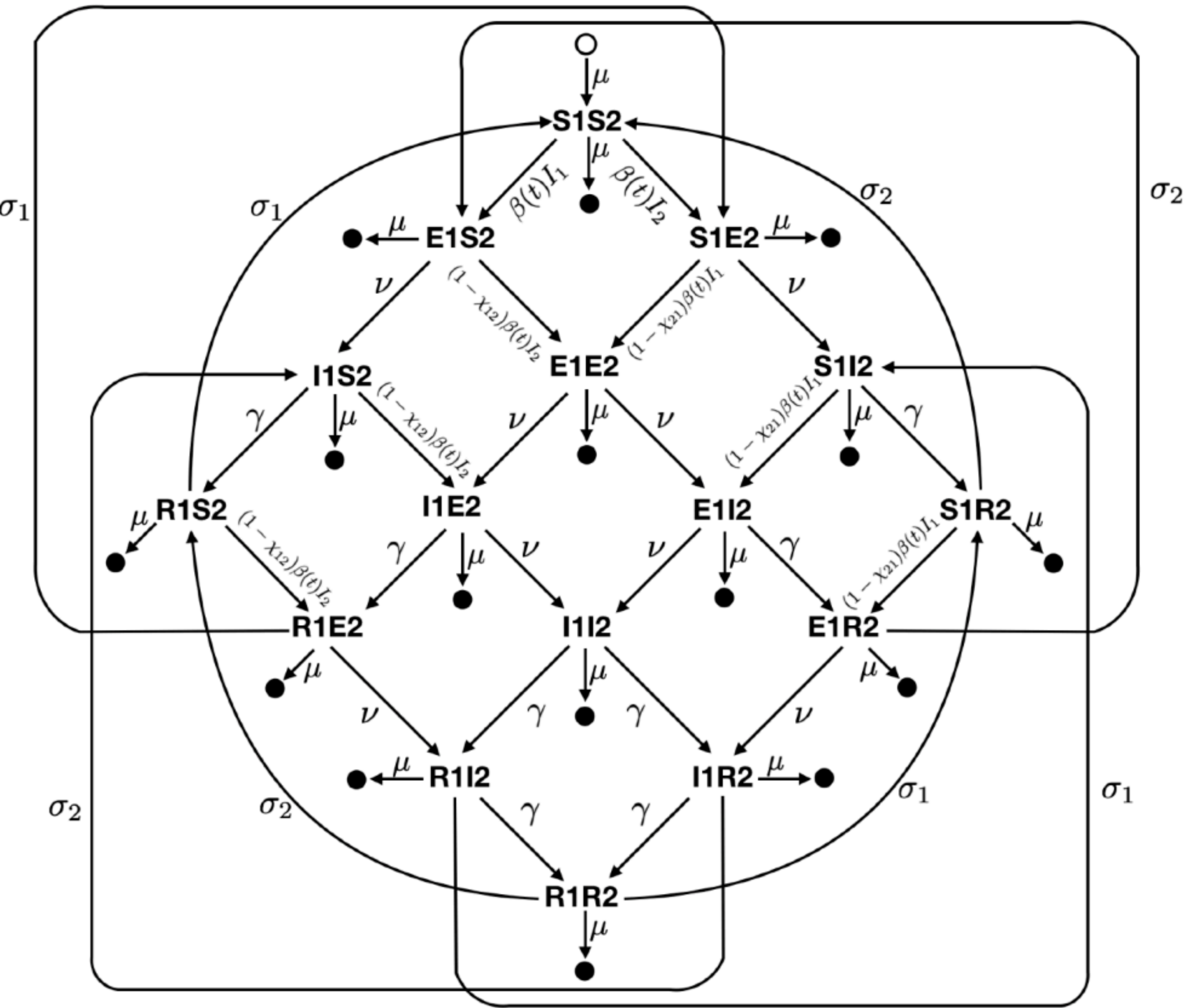
Two strains with waning immunity



- $\beta(t)$: seasonal (cosine with 1-year period) forcing
- $p_i(t)$: pulses of imported infectiousness from strain i
- ν : Rate of progression to infectiousness ($\frac{1}{\nu} = 1$ week)
- γ : Rate of recovery ($\frac{1}{\gamma} = 1$ week)
- σ : Rate of waning immunity ($\frac{1}{\sigma} = 35$ weeks)



The full model



Includes:

- Waning immunity (σ)
- Partial cross-immunity (χ)
- Seasonality ($\beta(t)$)